GEORGIA INSTITUTE OF TECHNOLOGY — OFFICE OF CONTRACT ADMINISTRATION

PROJECT ADMINISTRATION DATA SHEET

[x] ORIGINAL [ ] REVISION NO. ____

Project No. E-24-641 * DATE 10/15/81

Project Director: Dr. John A. White School/Lab ISyE

Sponsor: National Science Foundation; Washington, D.C. 20550

Type Agreement: Grant No. ISI-8115823

Award Period: From 9/15/81 To 2/28/83** (Performance) ------ (Reports)

Sponsor Amount: $48,524 (E-24-641) + $51,192 (A-3066) = $99,716 Contracted through: GTRI/GIT

Cost Sharing: $488 (E-24-331) + $510 (E-152-120) = $998

Title: Planning Project for a Material Handling Research Center

ADMINISTRATIVE DATA

OCA Contact Duane Hutchison x4820

1) Sponsor Technical Contact:

Alex Schwarzkopf, Program Officer
IUCRC, Industrial Support Section
Division of Industrial Science and
Technological Innovation; Directorate
for Scientific, Technological, and Interna-
tional Affairs; NSF; Washington, D.C. 20550
202/357-7527

2) Sponsor Admin/Contractual Matters:

Patrick A. Welsh, Grants Official
Section II, MPS/STIA Branch
Division of Grants & Contracts
Directorate for Administration
National Science Foundation
Washington, D. C. 20550
202/357-9671

Defense Priority Rating: None

Security Classification: None

RESTRICTIONS

See Attached NSF Supplemental Information Sheet for Additional Requirements.

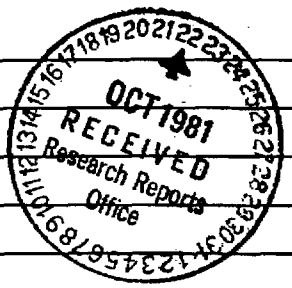
Travel: Foreign travel must have prior approval — Contact OCA in each case. Domestic travel requires sponsor approval where total will exceed greater of $500 or 125% of approved proposal budget category.

Equipment: Title vests with GIT

COMMENTS:

* Subproject is A-3066/Atkins - TAL

** Includes the usual 6 month unfunded flexibility period.



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FORM OCA 4:781

GEORGIA INSTITUTE OF TECHNOLOGY OFFICE OF CONTRACT ADMINISTRATION

SPONSORED PROJECT TERMINATION SHEET

Date 6/2/83

Project Title: Planning Project for a Material Handling Research Center

Project No: E-24-641

Project Director: John A. White

Sponsor: National Science Foundation

Effective Termination Date: 2/28/83

Clearance of Accounting Charges: 2/28/83

Grant/Contract Closeout Actions Remaining:

- [ ] Final Invoice and Closing Documents
- [X] Final ~~Fiscal Report~~ Acctg. Report FCTR
- [X] Final Report of Inventions
- [X] Govt. Property Inventory & Related Certificate
- [ ] Classified Material Certificate
- [ ] Other _____

Assigned to: ISyE (School/~~Laboratory~~)

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FORM OCA 10:781

E24-641

NATIONAL SCIENCE FOUNDATION
Washington, D.C. 20550

FINAL PROJECT REPORT
NSF FORM 98A

PLEASE READ INSTRUCTIONS ON REVERSE BEFORE COMPLETING

PART I–PROJECT IDENTIFICATION INFORMATION

1. Institution and Address	2. NSF Program	3. NSF Award Number
Georgia Tech 225 North Avenue Atlanta, GA 30332	ISTI	ISI 811 5823
	4. Award Period From 9/15/81 To 2/28/83	5. Cumulative Award Amount $99,716

6. Project Title

PLANNING GRANT FOR MATERIAL HANDLING RESEARCH CENTER

PART II–SUMMARY OF COMPLETED PROJECT *(FOR PUBLIC USE)*

The primary objective of this grant was to establish a plan and determine the feasibility of a self-sustaining Material Handling Research Center at Georgia Tech. The scope of the project consisted of designing and refining a research agenda and a center prospectus or plan which reflected both academic interests and industrial needs.

Two workshops were held where invited prospective member company people participated in a forum to determine industrial input both in the research area and center management and operations area. The inputs were obtained from the first workshop (May) and were tabulated and reflected in a second prospectus which was discussed formally at the second workshop (September).

At the second workshop, the research agenda and management plan were once again critiqued and opinions and ideas were collected which reflected the consensus of the interested member companies. It was obvious at the second workshop that there would be enough companies interested to meet our first year membership goal of 12 companies.

The Center was formally opened for operation at Georgia Tech October 1, 1982, with the anticipation of having 15 member companies the first year. The first Industry Advisory Board meeting was held December 1 and 2, 1982, with 17 members attending. The second Industry Advisory Board meeting was held January 26 and 27, with 20 companies having joined as charter members.

PART III–TECHNICAL INFORMATION *(FOR PROGRAM MANAGEMENT USES)*

1. ITEM *(Check appropriate blocks)*	NONE	ATTACHED	PREVIOUSLY FURNISHED	TO BE FURNISHED SEPARATELY TO PROGRAM	
				Check (✓)	Approx. Date
a. Abstracts of Theses					
b. Publication Citations					
c. Data on Scientific Collaborators					
d. Information on Inventions					
e. Technical Description of Project and Results		X			
f. Other *(specify)*					

2. Principal Investigator/Project Director Name *(Typed)*	3. Principal Investigator/Project Director Signature	4. Date
Dr. John A. White		4/15/83

NSF Form 98A (5-78) Supersedes All Previous Editions

Form Approved OMB No. 99R0114

INSTRUCTIONS FOR FINAL PROJECT REPORT
(NSF FORM 98A)

This report is due within 90 days after the expiration of the award. It should be submitted in two copies to:

National Science Foundation
Division of Grants and Contracts
Post-Award Projects Branch
1800 G Street, N.W.
Washington, D.C. 20550

INSTRUCTIONS FOR PART I

These identifying data items should be the same as on the award documents.

INSTRUCTIONS FOR PART II

The summary (about 200 words) must be self-contained and intelligible to a scientifically literate reader. Without restating the project title, it should begin with a topic sentence stating the project's major thesis. The summary should include, if pertinent to the project being described, the following items:

- The primary objectives and scope of the project.
- The techniques or approaches used only to the degree necessary for comprehension.
- The findings and implications stated as concisely and informatively as possible.

This summary will be published in an annual NSF report. Authors should also be aware that the summary may be used to answer inquiries by nonscientists as to the nature and significance of the research. Scientific jargon and abbreviations should be avoided.

INSTRUCTIONS FOR PART III

Items in Part III may, but need not, be submitted with this Final Project Report. Place a check mark in the appropriate block next to each item to indicate the status of your submission.

a. Self-explanatory.
b. For publications (published and planned) include title, journal or other reference, date, and authors. Provide two copies of any reprints as they become available.
c. Scientific Collaborators: provide a list of co-investigators, research assistants and others associated with the project. Include title or status, e.g. associate professor, graduate student, etc.
d. Briefly describe any inventions which resulted from the project and the status of pending patent applications, if any.
e. Provide a technical summary of the activities and results. The information supplied in proposals for further support, updated as necessary, may be used to fulfill this requirement.
f. Include any additional material, either specifically required in the award instrument (e.g. special technical reports or products such as films, books, studies) or which you consider would be useful to the Foundation.

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I. INTRODUCTION

A. Need for Material Handling Research

The reindustrialization of the United States is a topic of current and real concern to industry, government, and the university community. There is widespread agreement that U.S. productivity must be upgraded and that research will play an important role in the improvement of productivity; increased attention is being focused on the quality of U.S. production and the need for improved quality of both consumer and industrial products; and there is greater recognition of the relationship between productivity and quality.

One of the most significant areas of research having a major impact on productivity and quality is material handling. Regardless of the product manufactured, service performed, processes employed, level of automation used, or materials involved, all production processes have one thing in common--the need for material handling.

Material handling means much more than simply handling material. Today, material handling means handling, storing, and controlling material, with considerable emphasis on the latter. A comprehensive definition of material handling would include "using the right method to provide the right amount of the right material at the right place at the right time in the right condition and at the right cost."

If productivity means "doing more with less" and quality means "doing it right the first time", then it is apparent that material handling can have a significant impact on "qualitivity", i.e., increasing productivity through improved quality. Additionally, material handling affects the need for and levels of inventories.

In most companies, inventories of raw materials, supplies, tooling, work-in-process, and finished goods represent a sizeable opportunity for cost reduction. Economic pressures have focused increased attention from U.S. managers on the Toyota "just-in-time" system; which provides the necessary quantity of the necessary materials at the necessary place just-in-time; not too soon and not too late, but just-in-time!

In general, inventories are required because of an inability to control internal and/or external factors. For example, changes in prices, customer demand, product designs, production schedules and rates, delivery schedules, quality levels, set-up times and costs, labor attitudes, and organizational responsibilities can result in increased inventories.

In comparison with Germany, Japan, Sweden, and the United Kingdom relatively little material handling research has been performed in the United States. In general, equipment entries in the U.S. arena have tended to be either imports or modifications/improvements of foreign developed products. Furthermore, very little basic research has been devoted to issues related to the design of integrated material handling systems.

Traditional approaches in designing material handling systems typically focus on isolated point-to-point moves. Such a process frequently results in the creation of "islands of automation" in even the most modern manufacturing and distribution facilities, rather than truly automated systems. Robots, flexible machining systems, numerically controlled machine centers, and automated storage/ retrieval systems, for example, have been installed in a number of industries, but frequently they are not integrated with the remaining components of the production system. For example, it is often the case that automated equipment (production, handling, and storage equipment) is idle because material is unavailable. Alternately, congested conditions exist around these "islands of automation" because of a poorly designed material handling system.

Manufacturers of material handling equipment tend to respond to needs identified by the user of such equipment. As a result, material handling research and development performed by material handling equipment manufacturers represent predominately a passive response to short term needs, rather than an active response to long term opportunities.

Improvements in the handling, storage, and control of material in this country have generally tended to be evolutionary, rather than revolutionary. However, with the increased emphasis on factory automation, it is apparent that innovative approaches to handling, storing, and controlling materials will be required.

B. Establishment of a Material Handling Research Center

To help meet the material handling research needs of U.S. industry, a Material Handling Research Center was established at the Georgia Institute of Technology October 1, 1982. It was developed through a planning grant awarded by the National Science Foundation to do research toward the planning for the Industry/University Material Handling Research Center.

The award of the planning grant allowed Georgia Tech to plan the establishment of the Material Handling Research Center. Under the direction of Dr. John A. White, Professor of Industrial and Systems Engineering, the Material Handling Research Center will conduct basic and applied research on material handling related issues with the ultimate goal of improving productivity in U.S. industry; at the same time, it will have as a major objective strengthening industry/university relationships.

The Material Handling Research Center is being supported financially by its member companies and the National Science Foundation. However, it is planned that the Center become self-sufficient financially within five

years through its industrial membership. Toward this end, the research agenda for the Center has been developed to meet the needs of its members.

II. PLANNING PROCESS FOR CENTER

A. BACKGROUND

The planning for a Material Handling Research Center at Georgia Tech can be traced to a 1980 meeting of several Georgia Tech faculty members. At the meeting it was agreed to pursue the possibility of establishing a research center that would appeal to a broad cross-section of industry. The hope was to establish a research center that would be of interest to both manufacturing and distribution firms.

Based on Georgia Tech's reputation in material handling, it was decided to focus the effort on developing a Material Handling Research Center. It was felt initially that the Material Handling Research Center might be funded internally. This seemed to be reasonable due to Georgia Tech's strong position with industry. However, due to budgetary limits placed on the University System of Georgia, such a possibility was ruled out and other areas of funding were investigated. The National Science Foundation's Industry/University Cooperative Research Center program was one alternative considered.

B. PROPOSAL EFFORT

In the Spring of 1981, members of Georgia Tech's faculty met with members of NSF's Scientific, Technological, and International Affairs Directorate to discuss the Industry/University Cooperative Research Center Program. Based on that discussion, a proposal was prepared for an NSF grant to support the planning for a Material Handling Research Center. The proposal was submitted May 1981, with Dr. John A. White designated the principal investigator. Following a peer review in September 1981, the National Science Foundation awarded Georgia Tech a planning grant to study

the feasibility and to do the planning necessary for establishing an Industry/University Cooperative Research Center on Material Handling at Georgia Tech.

C. EFFORT IN ESTABLISHING INVITATION LISTS

One of the first tasks performed with the grant was the identification of candidates for membership in the Material Handling Research Center. Both users and suppliers of material handling equipment were considered. Trade magazines, attendance lists of material handling conferences and seminars, and Georgia Tech alumni records were reviewed in compiling a list of over 250 U.S. companies to be contacted.

Names of individuals to contact were developed by drawing on the personal contacts of Georgia Tech personnel reviewing annual reports of several corporations, and consulting Dun & Bradstreet and Thomas Register publications. A list of over 400 people was compiled through the planning effort. Where available, the list included the Chairman of the Board, President, Vice President of Engineering, and/or Vice President of Research of each company as well as specific middle managers known to be strongly supportive of material handling research.

A letter describing the plan to establish an industry/university cooperative research center was sent to each individual from Dr. Thomas E. Stelson, Vice President, Research at Georgia Tech. Based on visits to numerous U.S. corporations and discussions of research needs, a draft copy of a prospectus for the Center was prepared and a workshop was planned. Arrangements were made for a workshop on May 13, 1982, and letters of invitation were sent by Dr. John A. White.

D. PREPARATION OF PROSPECTUS

During the same period of time, a prospectus for the Material Handling Research Center (hereinafter referred to as the MHRC) was being produced. The prospectus was sent to potential attendees prior to the May 13 workshop and was discussed at the workshop. The prospectus documented the purpose, center by-laws, management plan, operating procedures, and material handling research areas for the Center. Additionally, the prospectus contained a start-up plan which included the initial management plan and the initial research program. The initial research program considered such areas as (1) materials control; (2) warehouse automation; (3) robotics and material handling; (4) factory automation; (5) logistics system, and (6) advanced material handling sensors. The final section contained a budget for planned personnel and equipment and a proposed contract agreement between the member companies and the Material Handling Research Center.

E. MAY 13, 1982 MATERIAL HANDLING RESEARCH CENTER WORKSHOP

Invitations were sent to approximately 250 industry personnel for the May 13 workshop. The meeting was held at the Atlanta Hilton Hotel; the number of participants exceeded 100. Over 80 attended from industry. The participants were welcomed by Governor George Busbee and Dr. Thomas E. Stelson. Mr. Alex Schwarzkopf of the National Science Foundation described the NSF programs that interact with industry. Dr. John A. White moderated the workshop and gave presentations on the organization and various functions of the Center. He also discussed the proposed research areas for the MHRC.

The prospectus was discussed at length. Of particular interest were the management plan and operating procedures planned for the Center. Many of the industry representatives wished to clarify the MHRC contract between Georgia Tech and the member company.

A questionnaire was distributed during the workshop to obtain industry feedback. The feedback instrument was used to measure the interest in the proposed research areas and to determine if the management plan and operating procedures were agreeable to industry. The participants were asked to rate the research areas in terms of interest to their particular company.

F. TABULATION OF FEEDBACK RESULTS AND REVISION OF PROSPECTUS

Following the workshop, a tabulation was performed of the feedback obtained during the workshop. Based on the feedback, it was decided that the MHRC would not address bulk handling research issues. Additionally, it was decided that research would not be performed, in the near-term, on the development of higher level conversive computer languages.

Based on the feedback obtained, a new prospectus was developed to reflect the desires and needs of workshop participants. Changes were made in the descriptions of the research areas and in the management structure and operating procedures. The corporate agreement was modified to reflect the needs of industry and Georgia Tech. More detail and information were added to the descriptions of the different research areas. A copy of the revised prospectus was mailed to the interested participants, along with an invitation to attend a second planning workshop on September 14.

G. SEPTEMBER 14, 1982 WORKSHOP

Based on the attendance at the first workshop, an invitation list was developed for the September 14 workshop; it consisted of approximately 85 people. Several invitations were extended to people who were unable to participate in the May workshop. The revised prospectus was included with the invitation. Each individual was requested to provide feedback

concerning any changes or problems they had with the revised prospectus. Based on the responses obtained, a further revision of the prospectus was performed and the updated prospectus was distributed to participants at the September workshop.

The September workshop was attended by approximately 40 industry representatives from 30 companies. The workshop consisted of a brief introduction and some welcoming and introductory remarks from Alex Schwarzkopf of NSF and John A. White of Georgia Tech. The majority of the workshop consisted of faculty members describing their proposed areas of research for the MHRC. During the day, there was considerable interaction between the faculty and the industry representatives. Notes were kept and modifications were made to the proposed research as appropriate.

Each of the six research areas was described. The faculty members presented in abbreviated form the ideas they proposed to pursue. During the last hour of the meeting, discussions were held with the potential members to attempt to overcome any organizational and administrative problems. Of special concern were issues related to the corporate agreement, the period of confidentiality, and licensing to subsidiaries. Georgia Tech received commitments on that date from nine potential companies. A check for $30,000 was received from IBM and tentative commitments were obtained from six other companies, bringing the total to 15 companies.

H. TABULATION OF SEPTEMBER WORKSHOP RESULTS

The tabulation of the feedback from the September workshop reflected that the research center was oriented in the proper direction. Furthermore, it appeared as though membership commitments were sufficient

to warrant National Science Foundation support and to establish formally the Material Handling Research Center.

III. START-UP OF THE CENTER

A. Establishment of the Center

On October 1, 1982 the Material Handling Research Center was formally established by Dr. Joseph M. Pettit, President of Georgia Tech. Letters of invitation were distributed on October 6, 1982 to those companies indicating an interest in supporting Georgia Tech's research effort.

To allow the Center to begin operation, Georgia Tech established an account with a "line of credit" of $120,000. The account permitted recruitment of Graduate Research Assistants and the support of the faculty.

B. December 1-2, 1982, Industry Advisory Board Meeting

The first meeting of the Industry Advisory Board was held on the Georgia Tech camput December 1 and 2, 1982. The membership status, chairman of the IAB, budgets, and research areas were discussed. As of December 1, 17 companies had committed to join and included the following:

Coca Cola	IBM	Stanley-Vidmar
Data General	Litton UHS	Texas Instruments
Digital	Lockheed-Georgia	Union Metal
DuPont	Lyon Metal Products	Westinghouse
Eastman Kodak	Sears	Xerox
Grumman	SI Handling Systems	

Additionally, General Dynamics participated, since they were nearing approval to join.

C. January 26-27, 1983, Industry Advisory Board Meeting

The second Industry Advisory Board Meeting was held on January 26-27, 1983. The first day of the meeting consisted on small group meetings of the Technical Monitors/Industry Advisory Board with the research faculty to discuss the direction and focus of the research. The second day involved the IAB in discussion of the budget, and equipment and publication policies.

By this meeting Boeing, General Dynamics, General Motors had also become part of the MHRC.

IV. CONCLUSION

In conclusion, it appears as though the National Science Foundation grant has been a worthwhile endeavor. There were many obstacles to overcome to get to the point of having 20 member companies and as we now know there are still many other problems that have to continually be pursued in order to keep the center viable and responsive to member companies needs and still work within the university framework. It has been an effort to introduce to the university the different company systems and expectations. It has, on the other hand, been a tremendous effort to explain to the company representatives the restraints that exist within the university environment. It has taken some understanding and effort on both the part of the university and the body of companys in order to bring this center into being and into focus.

The Material Handling Research Center Charter Corporate Membership includes:

Boeing	General Motors	SI Handling Systems
Coca Cola	Grumman	Stanley-Vidmar
Data General	IBM	Texas Instruments
Digital	Litton UHS	Union Metal
DuPont	Lockheed-Georgia	Westinghouse
Eastman Kodak	Lyon Metal Products	Xerox
General Dynamics	Sears	